Welcome to NASA Applied Remote Sensing Training (ARSET) Webinar Series

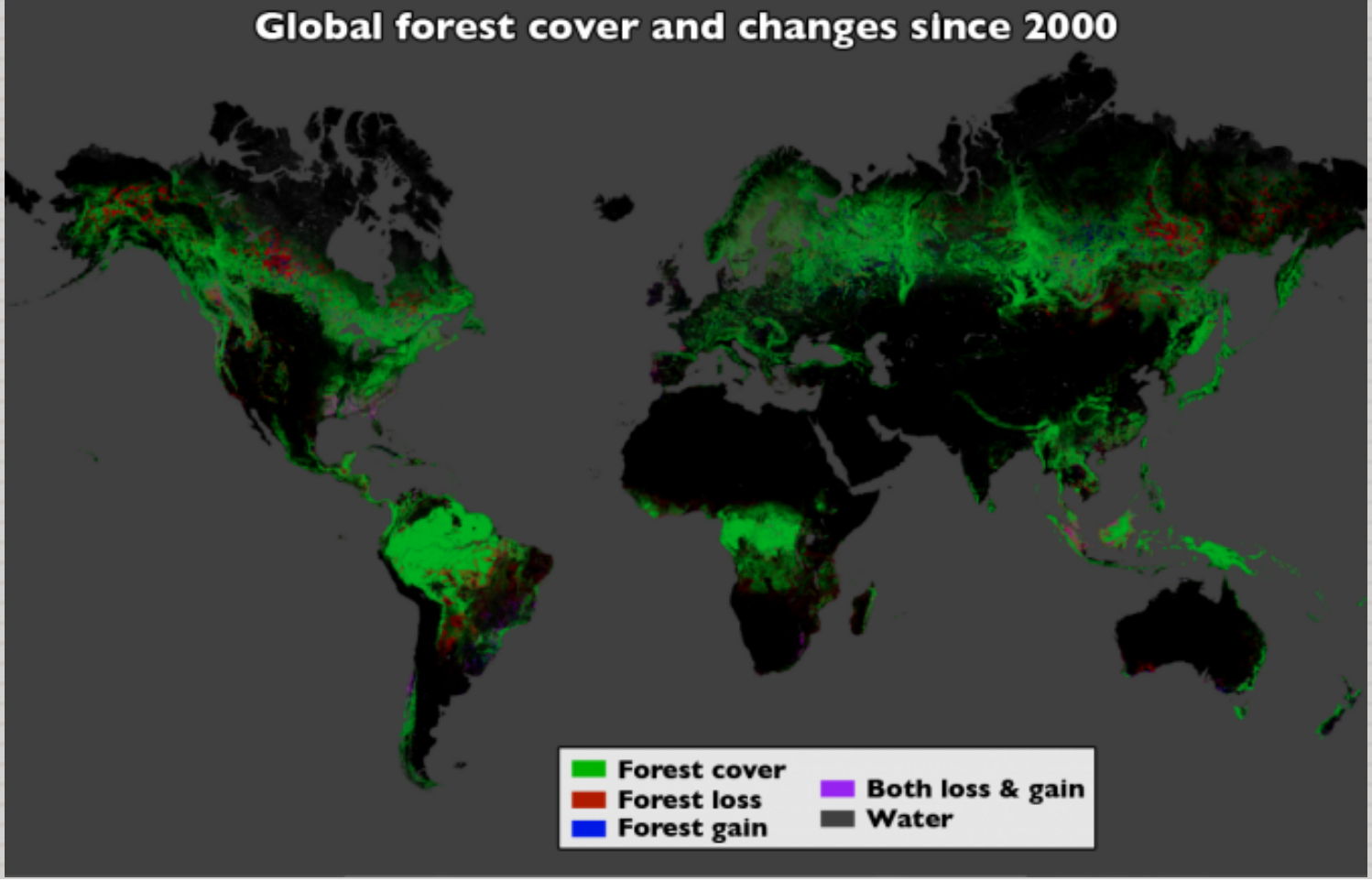
Introduction to Remote Sensing Data for Land Management

Course Dates: Every Monday, November 3- December 1
Time: 12pm-1pm EDT

Landsat, Global forest cover and change since 2000.

(NASA Goddard, based on data from Hansen et al., 2013)

November 17, 2014



Thank You!!

Cindy Schmidt
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Welcome to NASA Applied Remote Sensing Training (ARSET) Webinar Series

Introduction to Remote Sensing Data for Land Management

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Important Information

- Presentations and recorded links URL:
  - http://arset.gsfc.nasa.gov/webinars
- Certificate of Completion
  - Attend all 5 webinars
  - Assignment 1 – download from training website or from the ARSET land webinar website
  - Assignment 2- after Week 4

ARSET Land Resource Management

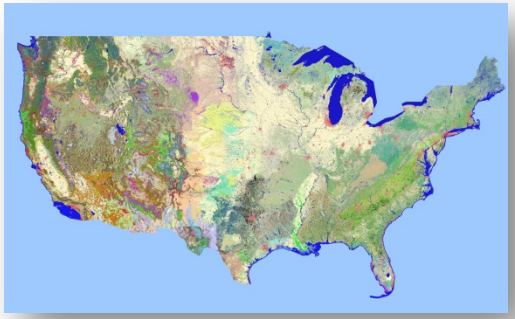
http://arset.gsfc.nasa.gov/eco/webinars/

Course Outline

Week 1

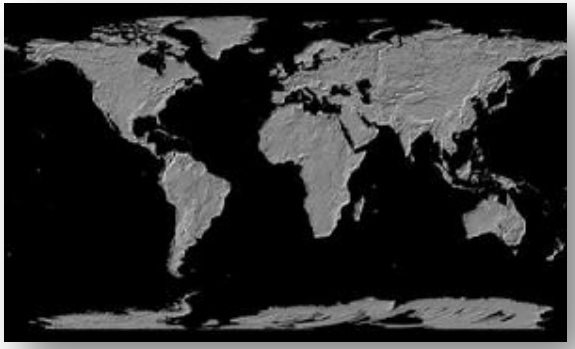
Intro. & Background: Satellite Remote Sensing

Week 2



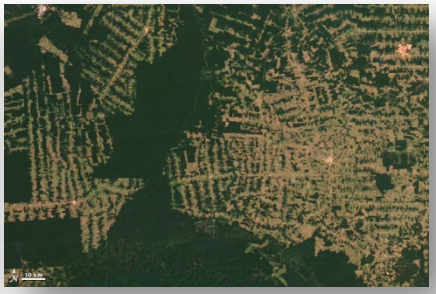
Land Cover Mapping/ Web tools for data access

Week 3



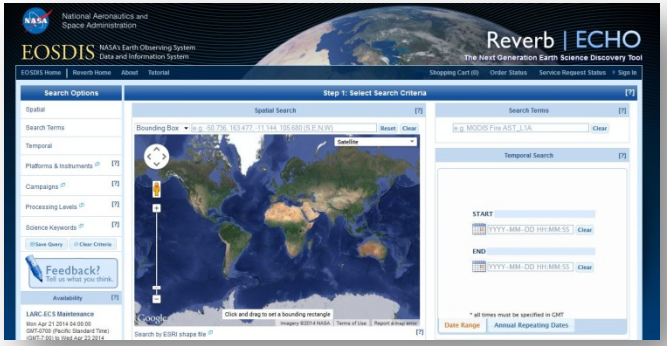
Terrain

Week 4



Change Detection

Week 5



Web tools for data access/ Integration with GIS

Your Course Instructors for This Week

- Amber Kuss (ARSET)
  - amberjean.m.kuss@nasa.gov
- Lindsey Harriman (LP DAAC)
  - Science Communications Lead
  - lharriman@usgs.gov
- Kelly Lemig (LP DAAC)
  - User Services Technical Lead
  - klemig@usgs.gov

General inquiries about ARSET: Ana Prados (ARSET) aprados@umbc.edu

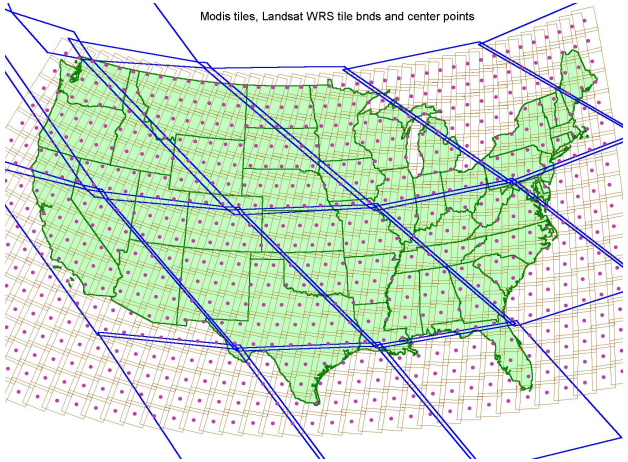
Outline

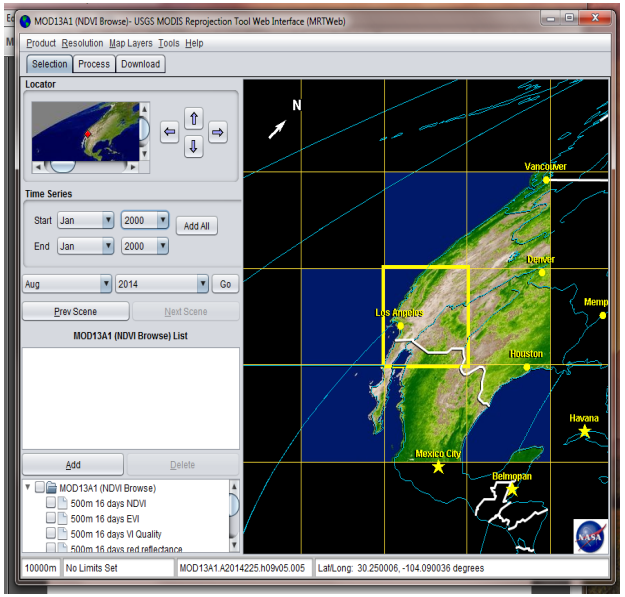
- Brief review of last week
- Terrain Data in the LP DAAC
  - Overview of what terrain data can be used for
  - ASTER Global Digital Elevation Model (GDEM)
    - Product overview, visuals, case study, access points
  - NASA SRTM Version 3.0
    - Products overview, visuals, case study, access points
- Live Demo
  - Global Data Explorer (GDEx)

Review of Week 2

Week 2

- Data Processing Levels
  - Levels 1 and 2: highest spatial and temporal resolution
  - Levels 3 and 4: derived products, lower resolution
- Landsat Data Overview
  - Passive sensor
  - Band overview and resolution
  - Where to obtain imagery
- MODIS Data Overview
  - Passive sensor
  - Band overview and resolution
  - Where to obtain imagery
- Live Demo: MRT Web





LP DAAC Overview and Live Demo

Terrain Data at the LP DAAC

Lindsey Harriman, Innovate! Inc. & Kelly Lemig, ERT, Inc.
Contractors to the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center Sioux Falls, South Dakota

***Work performed under USGS contract G10PC00044**

U.S. Department of the Interior
U.S. Geological Survey

Overview of Terrain Data at the LP DAAC:

Lindsey Harriman, Innovate!, Inc.
LP DAAC Science Communications Lead
lharriman@usgs.gov

Demonstration of Global Data Explorer (GDEx):

Kelly Lemig, ERT, Inc.
LP DAAC User Services Technical Lead
klemig@usgs.gov

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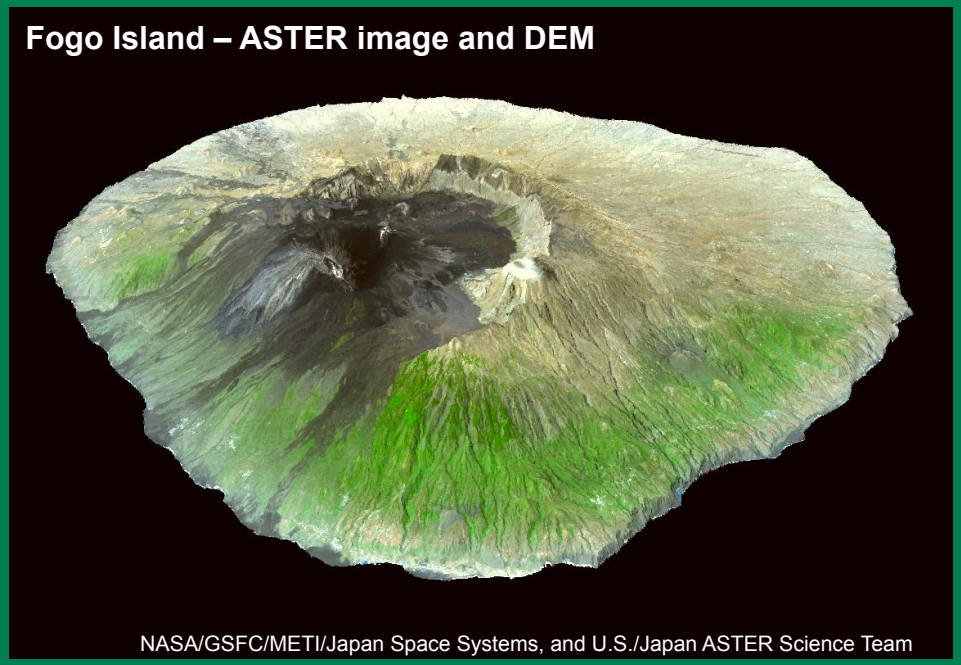
Terrain Data and Land Management

- Visualize satellite data in 3D
- Map
  - Hazardous terrain
- Calculate
  - Slope and aspect
  - Catchment area
  - Forest canopy height
- Model
  - Runoff
  - Stream networks
  - Landslides



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Sources of Terrain Data

- GPS points
- Airborne and Satellite images
  - Photogrammetrically collect points or breaklines
  - Terra Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)
- Radar
  - Light Detection and Ranging (lidar)
  - Shuttle Radar Topography Mission (SRTM)
- Sonar

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NASA LP DAAC

- LP DAAC = Land Processes Distributed Active Archive Center
- One of 12 of NASA's discipline-oriented data centers
- Located in Sioux Falls, SD at the USGS Earth Resources Observation Science (EROS) Center
- Processes, archives, and distributes remotely sensed land data products to the civilian remote sensing community
- https://lpdaac.usgs.gov

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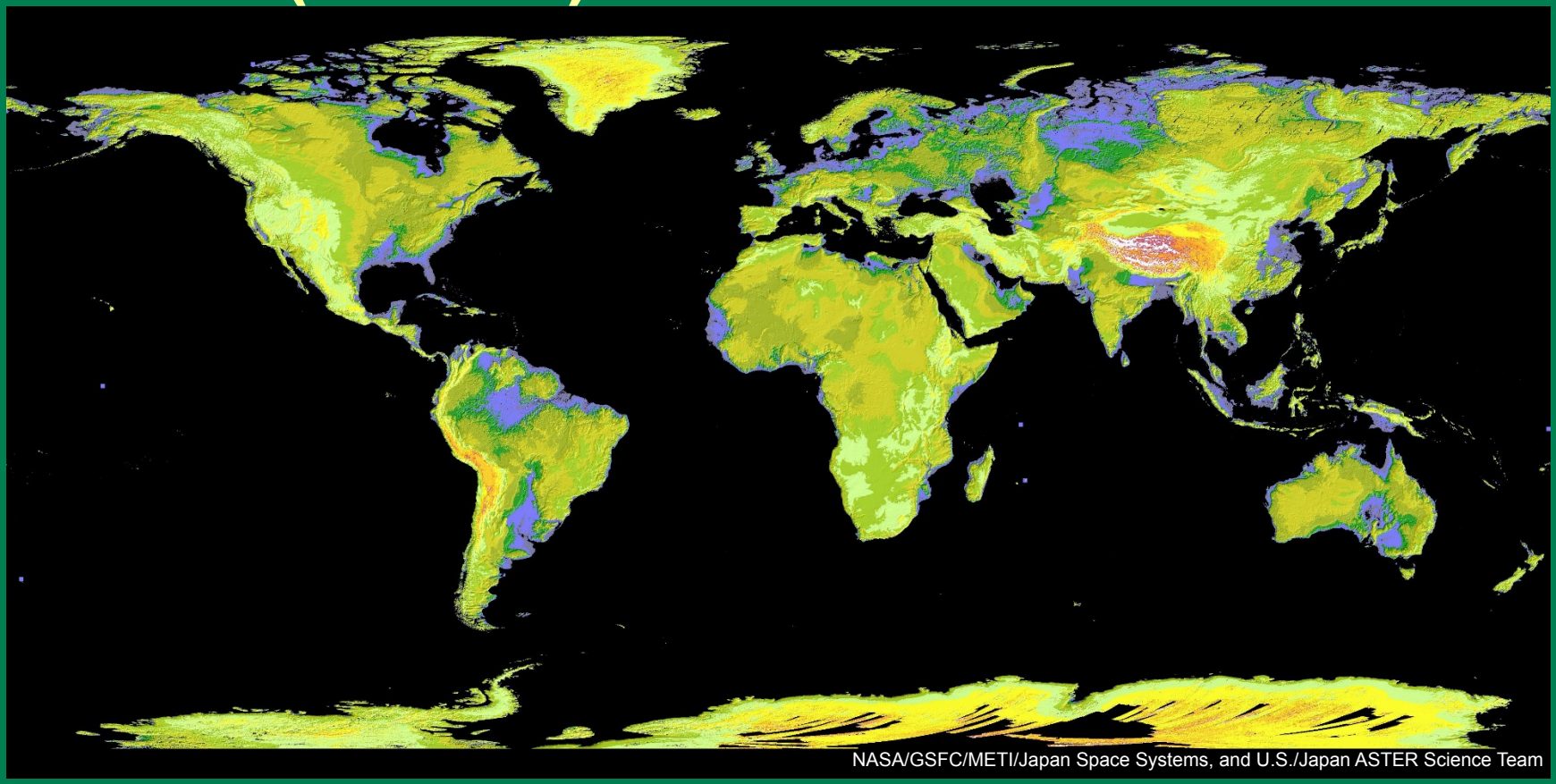
ASTER Global Digital Elevation Model (GDEM)



https://lpdaac.usgs.gov/products/aster_products_table/astgtm

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What is ASTER?

- ASTER
  - Advanced Spaceborne Thermal Emission and Reflection Radiometer
  - Onboard NASA Terra satellite
  - Developed jointly by NASA and Japan's Ministry of Economy, Trade, and Industry (METI)
- Bands
  - 3 – 15 m bands in Visible & Near-infrared (VNIR)
  - 6 – 30 m Shortwave Infrared (SWIR)
  - 5 – 90 m Thermal Infrared (TIR)

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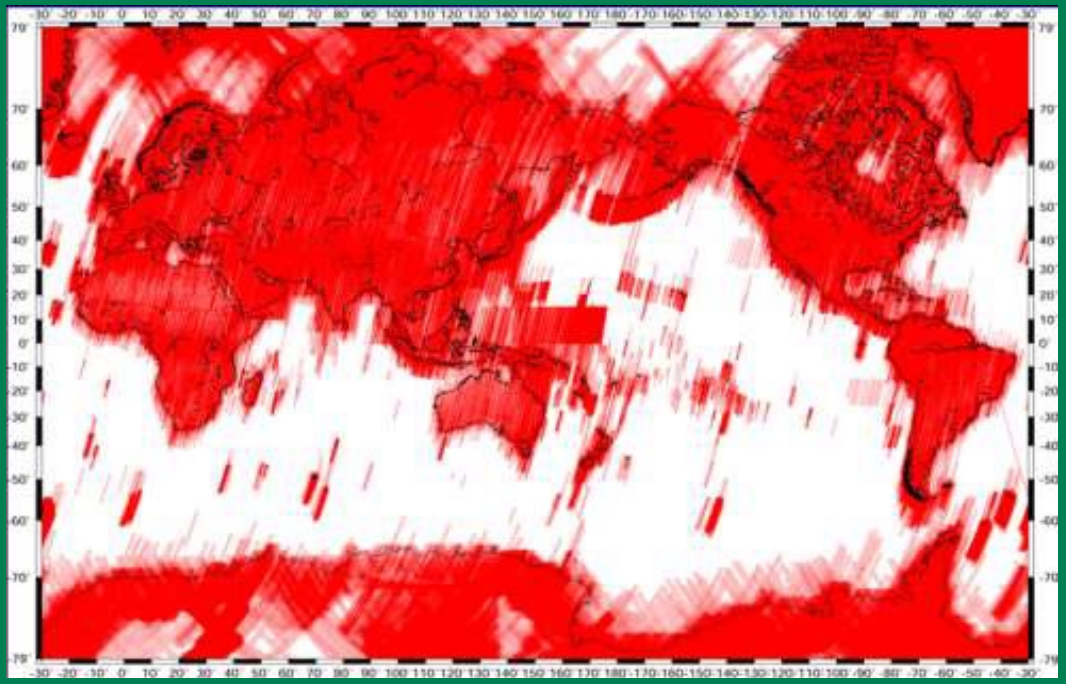
ASTER Acquisition and Coverage

- Data collected since 2000
- ~2.5 million scenes
- ~515 scenes/day
- Global coverage
  - Taskable
  - Pointable
- Expedited



Spatial and temporal coverage may vary

- ASTER can collect in stereo (3D) in the NIR using nadir- and aft-looking near infrared cameras

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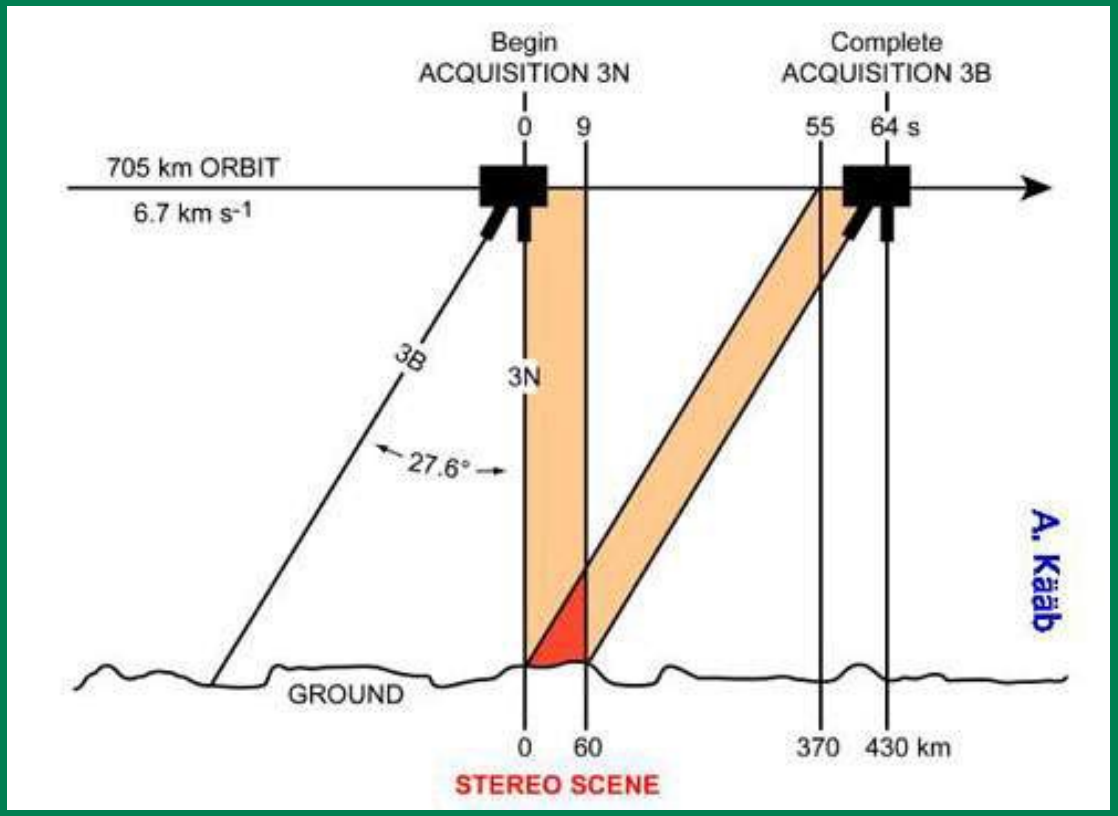
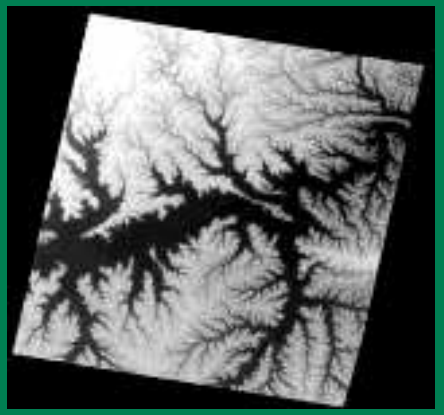
Stereo Vision in the NIR



Courtesy: Global Land Ice Measurements from Space (GLIMS Switzerland).
http://www.geo.unizh.ch/~kaeaeb/glims/glims.html



AST_14DEM

Courtesy: NASA & USGS

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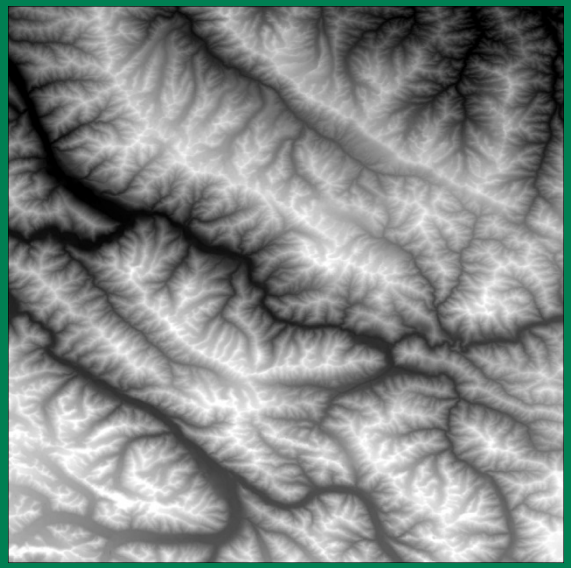
What is ASTER GDEM?

- Global Digital Elevation Model (GDEM)
- Product of METI and NASA
- Version 1 released June 29, 2009
  - 1.3 million ASTER VNIR scenes (as stereo-pairs) were used to produce single scene DEMs
  - Data from 2000 - 2008
- Improved Version 2 released October 17, 2011
  - Incorporated 260,000 more stereo-pairs from ASTER images collected after September 2008
- Freely available; redistribution restricted



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ASTER GDEM Characteristics

- **Short name: ASTGTM**

Data Set Characteristics

Tile Size	3601 x 3601 (1 degree by 1 degree)
Pixel Size	1 arc-second
Geographic coordinates	Geographic latitude and longitude
DEM output format	GeoTIFF, signed 16 bits in units of vertical meters
Geoid reference	WGS84/EGM96
Special DN values	-9999 for void pixels, and 0 for sea water body
Tile volume	25 MB uncompressed, 4–5 MB compressed
Coverage	North 83 degrees to south 83 degrees, 22,702 tiles

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ASTER GDEM Characteristics (Cont'd)

Layers

Data Fields	Units	Data Type	Valid Range	Fill Value
Elevation (".dem")	Meters	16-bit signed integer	-500–9,000 (0 at sea level)	-9999
QA (".num")	None	16-bit signed integer	0–200	-1 SRTM3 V3 -2 SRTM3 V2 -5 NED -6 CDED -11 Alaska DEM

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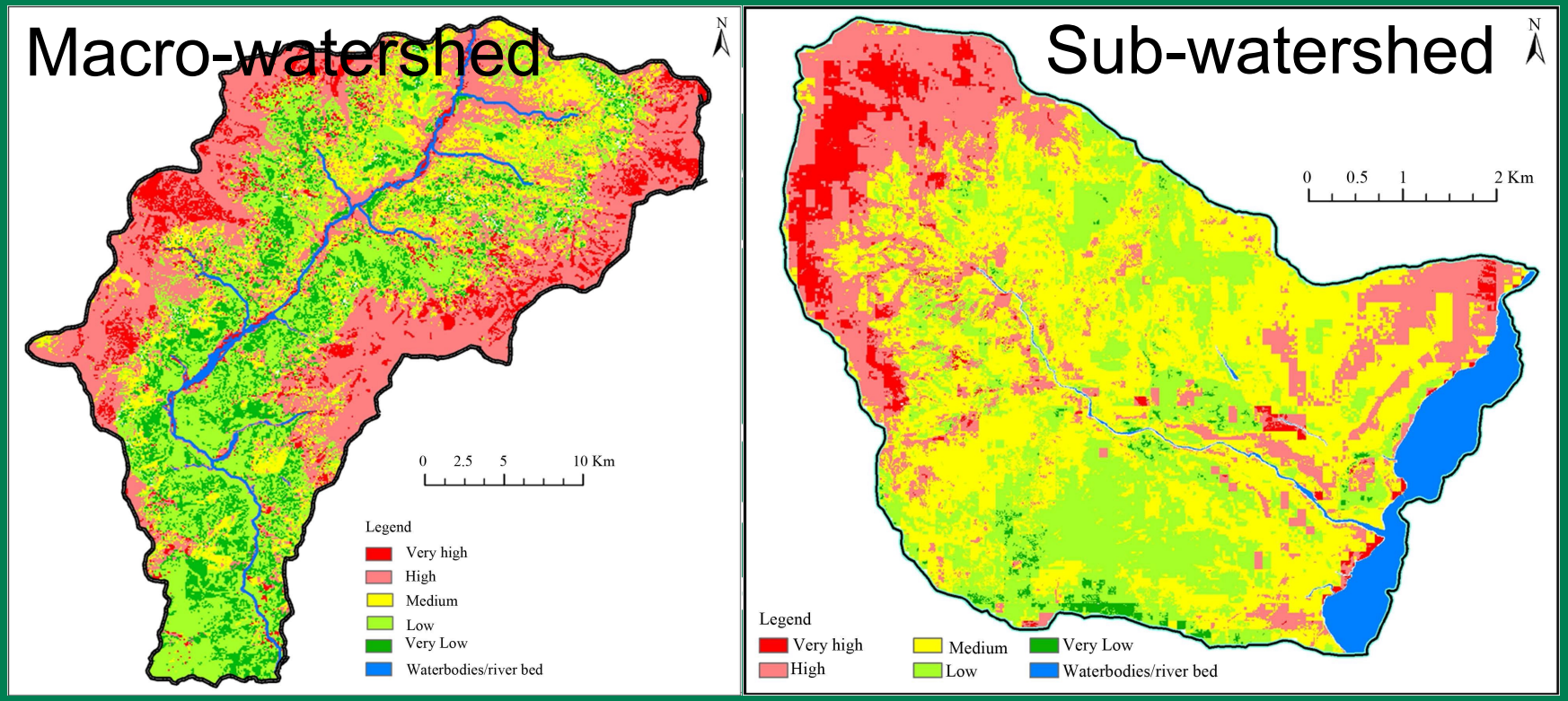
ASTER GDEM Use Case



Uddin, K.D., M.; Joshi, G., 2014, An Optical High and Medium Spatial Resolution Approach for Erosion-Prone Areas Assessment in Mustang, Nepal: International Journal of Geosciences, v. 5, p. 383-393. [Also available at http://dx.doi.org/http://dx.doi.org/10.4236/ijg.2014.54037.]

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How to Access ASTER GDEM

- **Reverb:**
  http://reverb.echo.nasa.gov/reverb
- **GDEx (demo today):**
  http://gdex.cr.usgs.gov/gdex/
- **Japan Space Systems GDEM:**
  http://gdem.ersdac.jspacesystems.or.jp/

- **More information:**
  https://lpdaac.usgs.gov/products/aster_products_table/aster_gdem_version_2_validation

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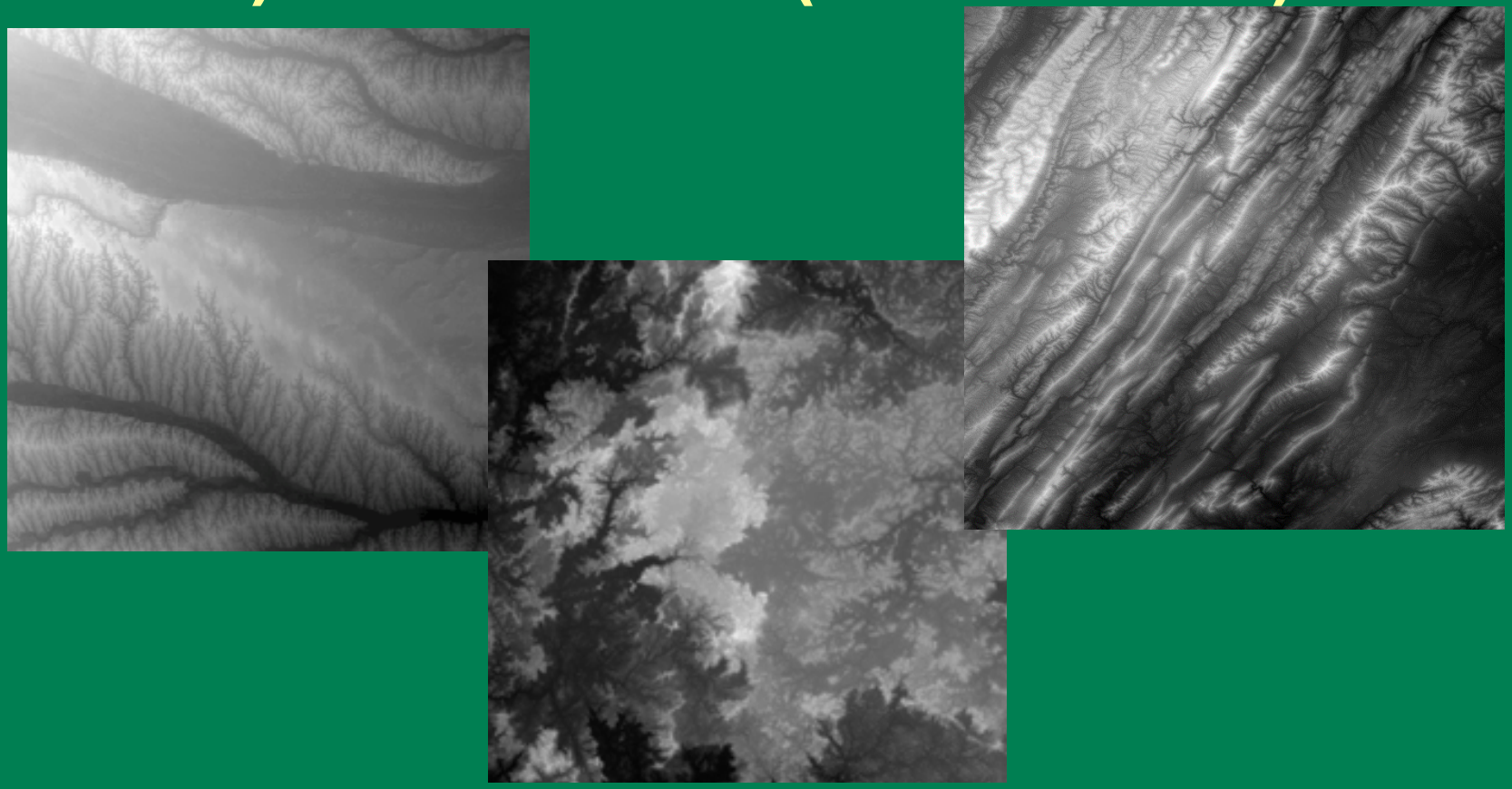
Shuttle Radar Topography Mission (SRTM) Version 3.0 (SRTM Plus)



https://lpdaac.usgs.gov/products/measures_products_table

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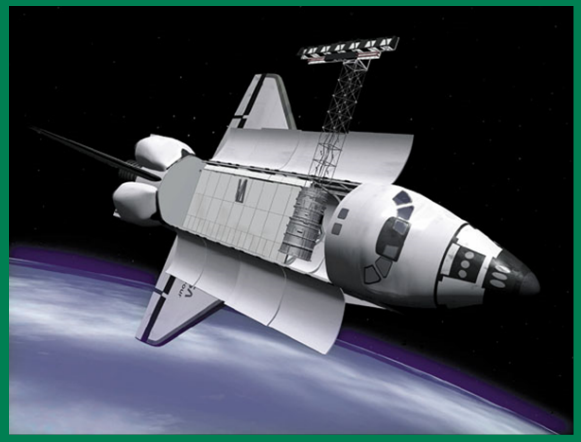
What is SRTM?

- NASA mission completed in February 2000
- Consisted of 176 orbits around Earth in 11 days
- Acquired DEM of all land between 60°N and 56°S latitude, about 80% of Earth's total landmass



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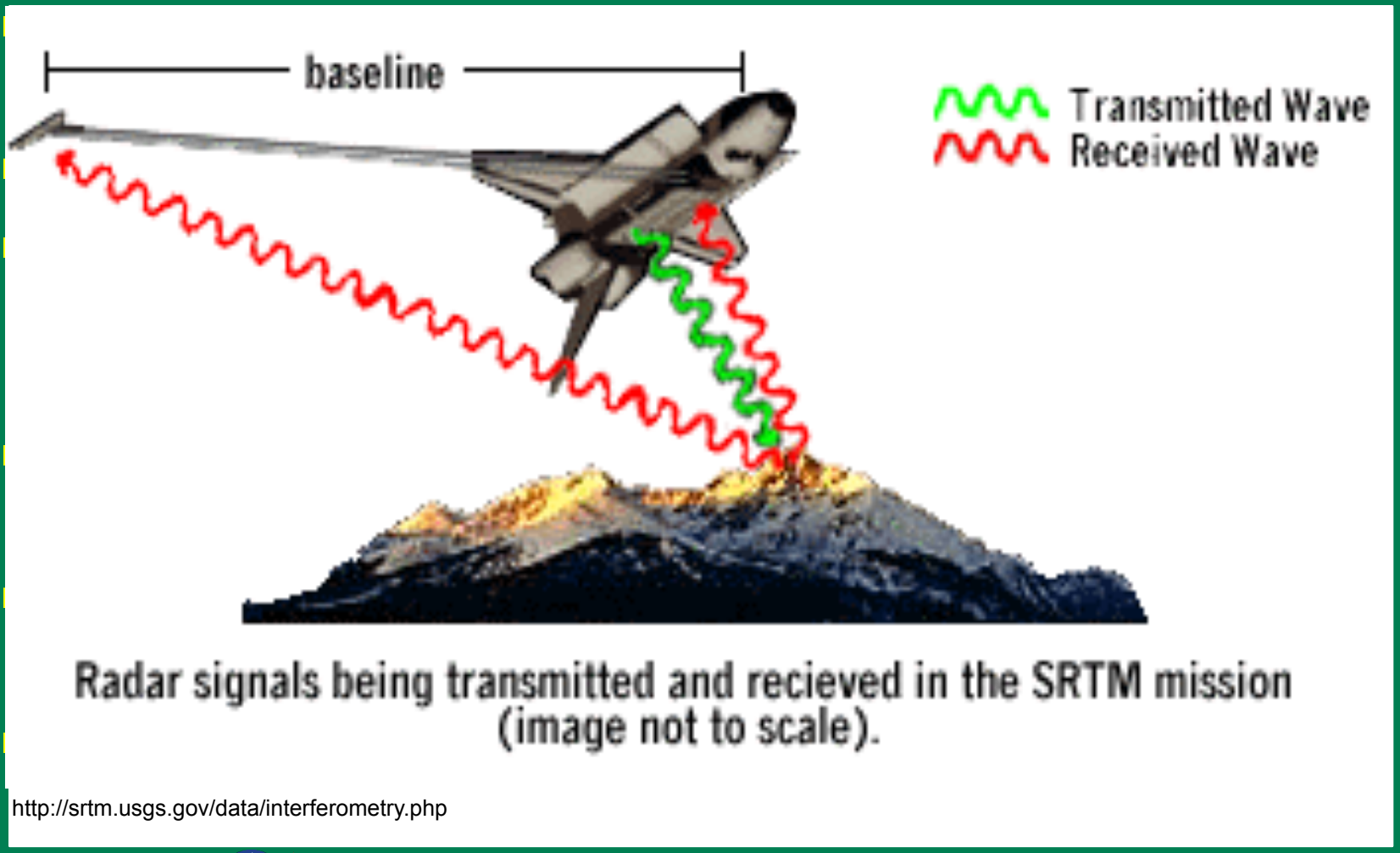
NASA SRTM Version 3.0 (SRTM Plus)



Radar signals being transmitted and recieved in the SRTM mission (image not to scale).

http://srtm.usgs.gov/data/interferometry.php

USGS NASA

NASA SRTM v3 Characteristics

Tile size	1° by 1°
Pixel size	1 arc second (~30 meters) or 3 arc seconds (~90 meters)
Geographic coordinates	Geographic latitude and longitude
Output format	DEMS: .HGT, 16-bit signed integer, in units of vertical meters Number: .NUM
Geoid reference	WGS84/EGM96
Special DN values	N/A - No voids in v3
Coverage	60°N to 56°S latitude U.S. and Territories Africa

USGS NASA

NASA SRTM v3 Products

Short Name	Collection	MEaSUREs Data Product	Spatial Resolution
SRTMGL1	SRTM	SRTM Global 1 arc second	1 arc-second
SRTMGL1N	SRTM	SRTM Global 1 arc second number	1 arc-second
SRTMGL3	SRTM	SRTM Global 3 arc second	3 arc-second
SRTMGL30	SRTM	SRTM Global 30 arc second	30 arc-second
SRTMGL3N	SRTM	SRTM Global 3 arc second number	3 arc-second
SRTMGL3S	SRTM	SRTM Global 3 arc second sub-sampled	3 arc-second
SRTMSWBD	SRTM	SRTM Water Body Data Shapefiles & Raster Files	1 arc-second
SRTMUS1	SRTM	SRTM US 1 arc second	1 arc-second
SRTMUS1N	SRTM	SRTM US 1 arc second number	1 arc-second

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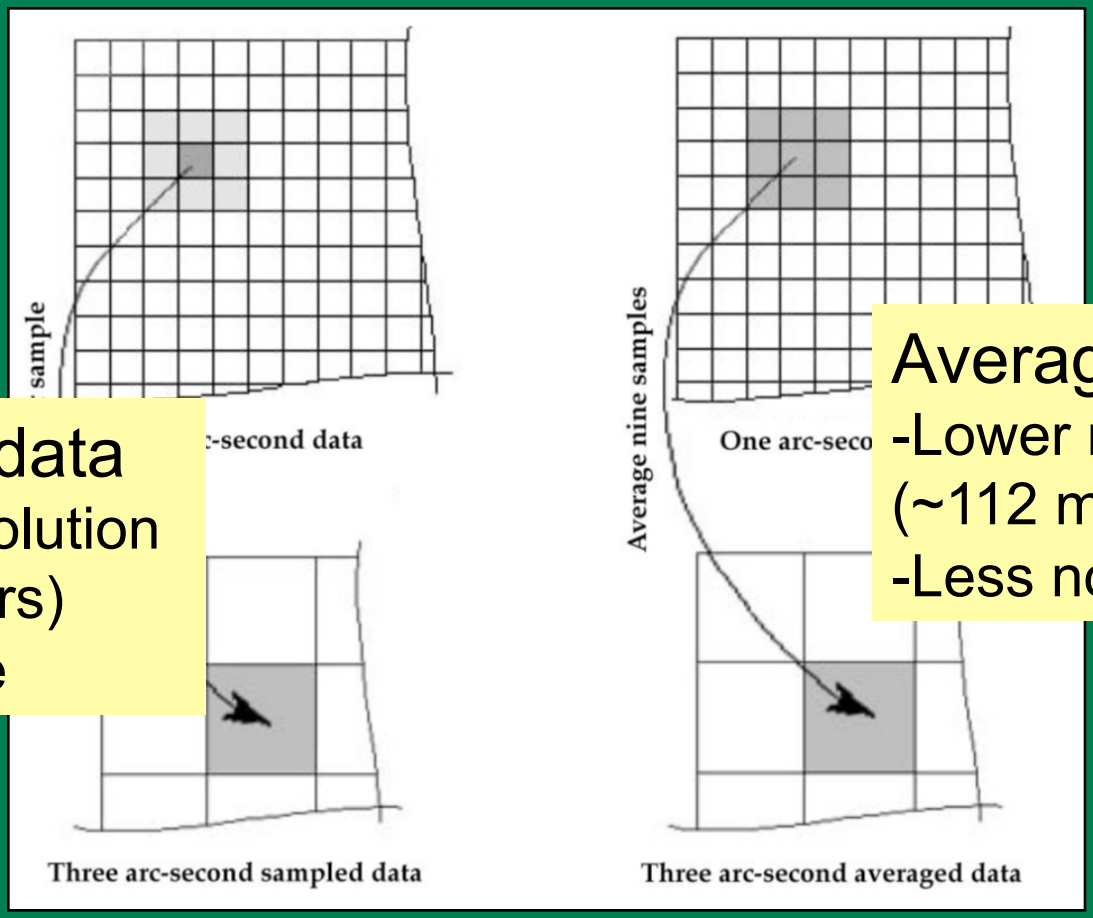
Sampling Methods: Global 3 arc second data

SRTMGL3S **SRTMGL3**



Sampled data
-Higher resolution (~100 meters)
-More noise

Averaged data
-Lower resolution (~112 meters)
-Less noise

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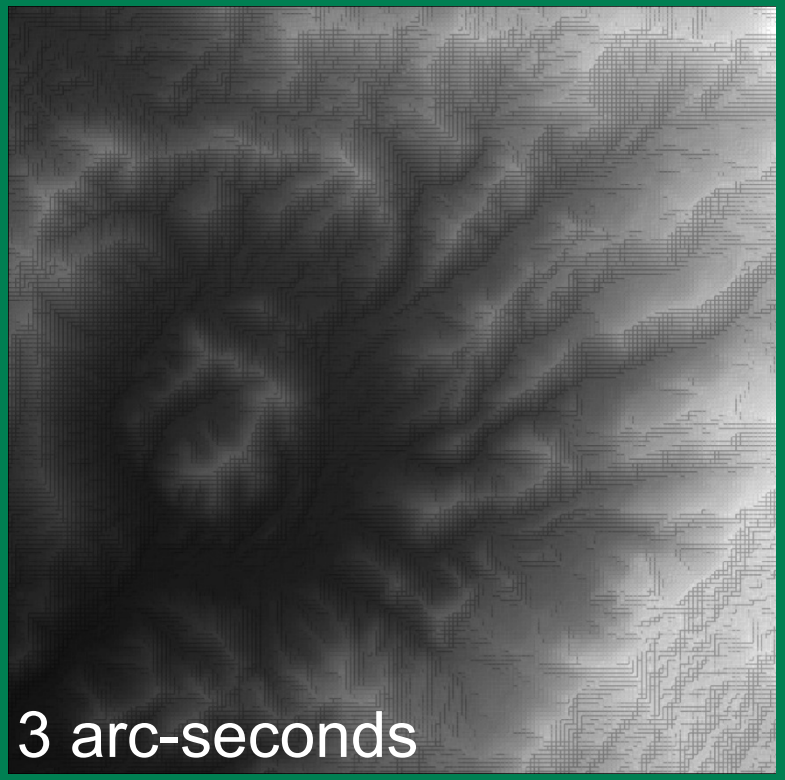
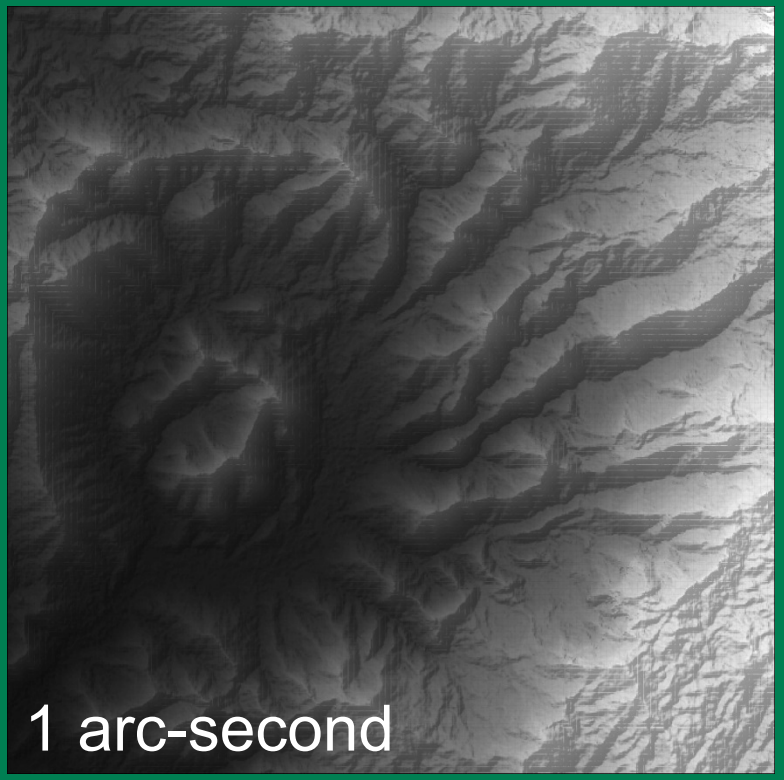
NASA SRTM v3

Mount Elgon, Uganda



http://dx.doi.org/10.5067/MEaSUREs/SRTM/SRTMGL3.003



http://dx.doi.org/10.5067/MEaSUREs/SRTM/SRTMGL1.003

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SRTM Data Use Case

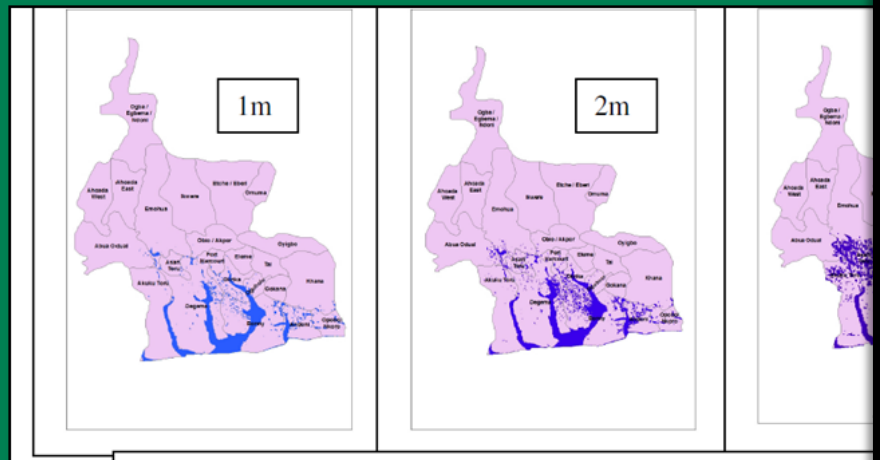

Fig 3.4. Potential LGA areas of Flooding for 1m, 2m and 3m Sea

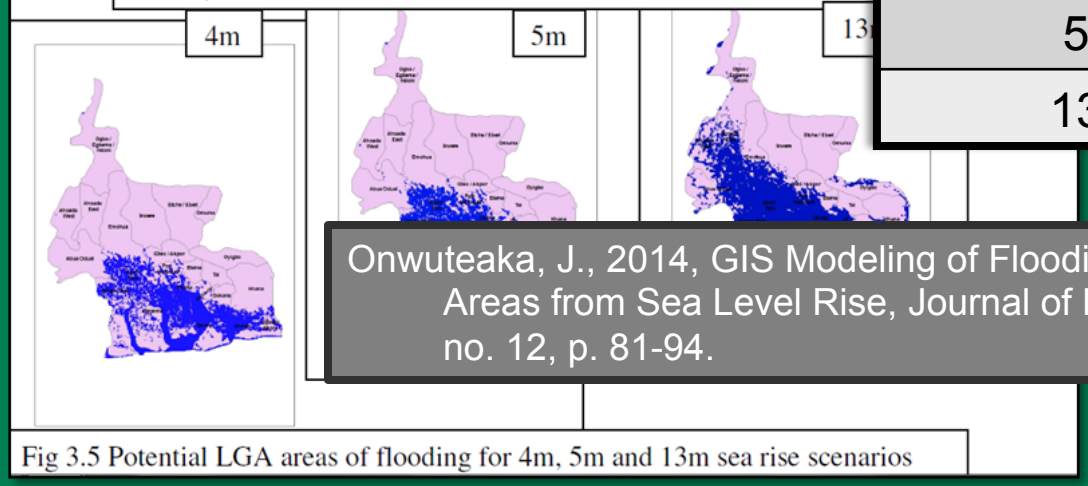

Fig 3.5 Potential LGA areas of flooding for 4m, 5m and 13m sea rise scenarios

Sea Level Rise Scenarios (m)	Affected Local Government Areas
1	10
2	12
3	12
4	13
5	13
13	22

Onwuteaka, J., 2014, GIS Modeling of Flooding Exposure in Nigerian Coastal Areas from Sea Level Rise, Journal of Environment and Earth Science v. 4, no. 12, p. 81-94.

USGS NASA

How to Access NASA SRTM v3

- **Reverb:**
  http://reverb.echo.nasa.gov/reverb
- **GDEx (demo today):**
  http://gdex.cr.usgs.gov/gdex/
- **Data Pool and DAAC2Disk:**
  https://lpdaac.usgs.gov/data_access/data_pool

- **More information: SRTM v3 User Guide**
  https://lpdaac.usgs.gov/sites/default/files/public/measures/docs/NASA_SRTM_V3.pdf

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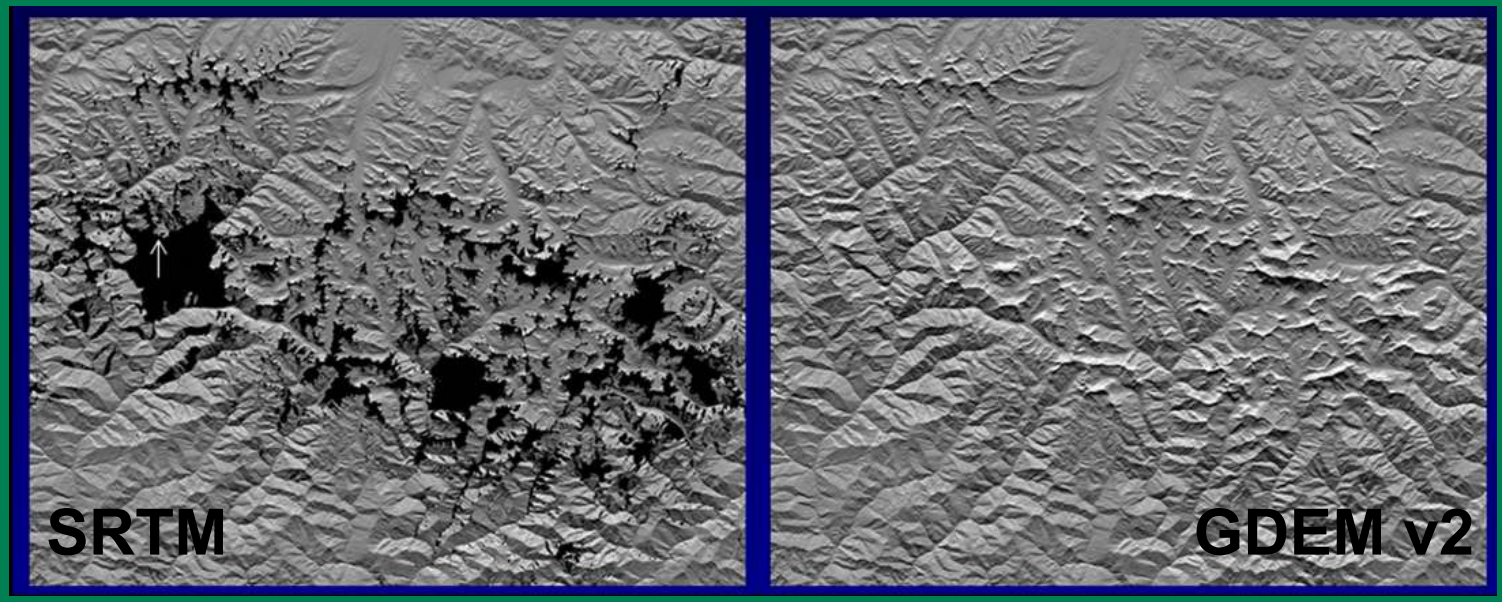
Choosing data: What to consider

- Topographical features
  - Mountainous areas
  - Desert areas or areas with a lot of snow cover



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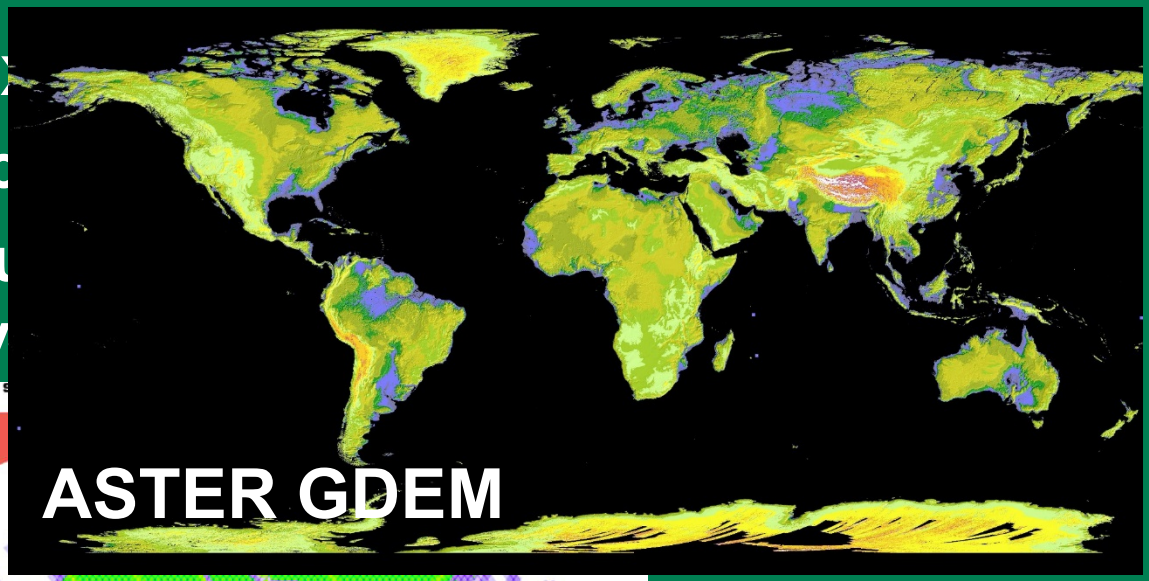
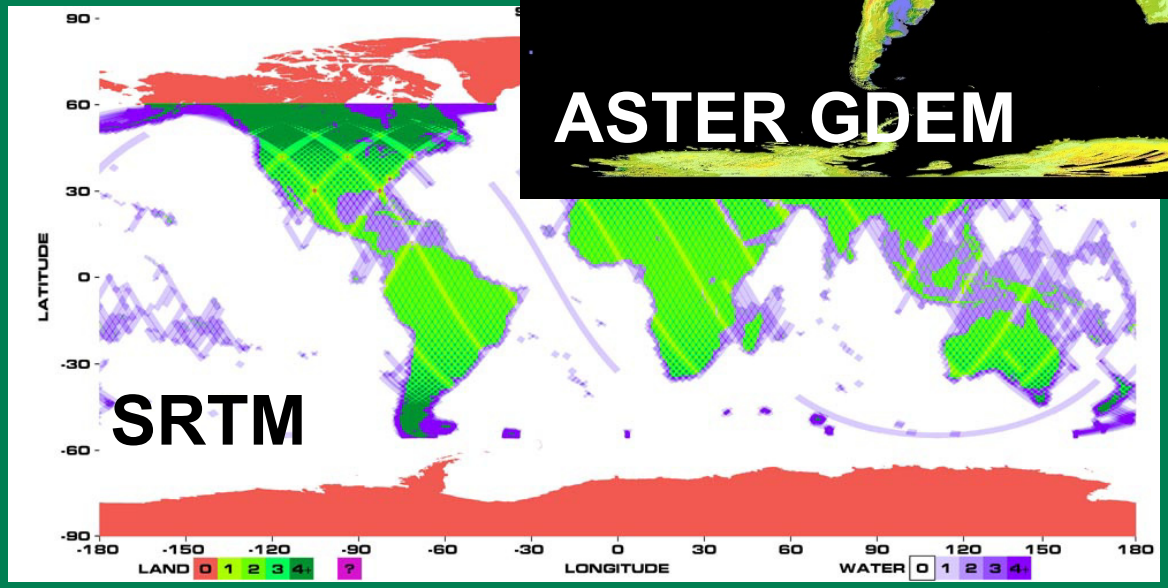
Choosing data: What to consider

- Geographic ex
  - Areas with co
  - Extreme latitu
    some data av





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Sources and Additional Reading

- ESRI, 2012. Types of source data supported in terrain datasets, http://resources.arcgis.com/en/help/main/10.1/index.html#//005v00000009000000
- JPL, 2005. SRTM: Frequently Asked Questions, www2.jpl.nasa.gov/srtm/faq.html
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- NASA JPL, 2009. Global Digital Elevation Model, http://asterweb.jpl.nasa.gov/gallery-detail.asp?name=gdem
- Tachikawa, T., Hato, M., Kaku, M., Iwasaki, A., 2011, Characteristics of ASTER GDEM Version 2, IGARRS 2011, Canada. https://lpdaac.usgs.gov/sites/default/files/public/aster/docs/Tachikawa_etal_IGARSS_2011.pdf

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Global Data Explorer (GDEX)

- Funded through NASA ROSES 2005 ACCESS Program
- A collaboration between the LP DAAC and George Mason University's Center for Spatial Information Science and Systems
- A seamless data viewer providing access to multiple sources of digital elevation data sets
- Users can subset and download data by area of interest in multiple formats and projections
- http://gdex.cr.usgs.gov/gdex/

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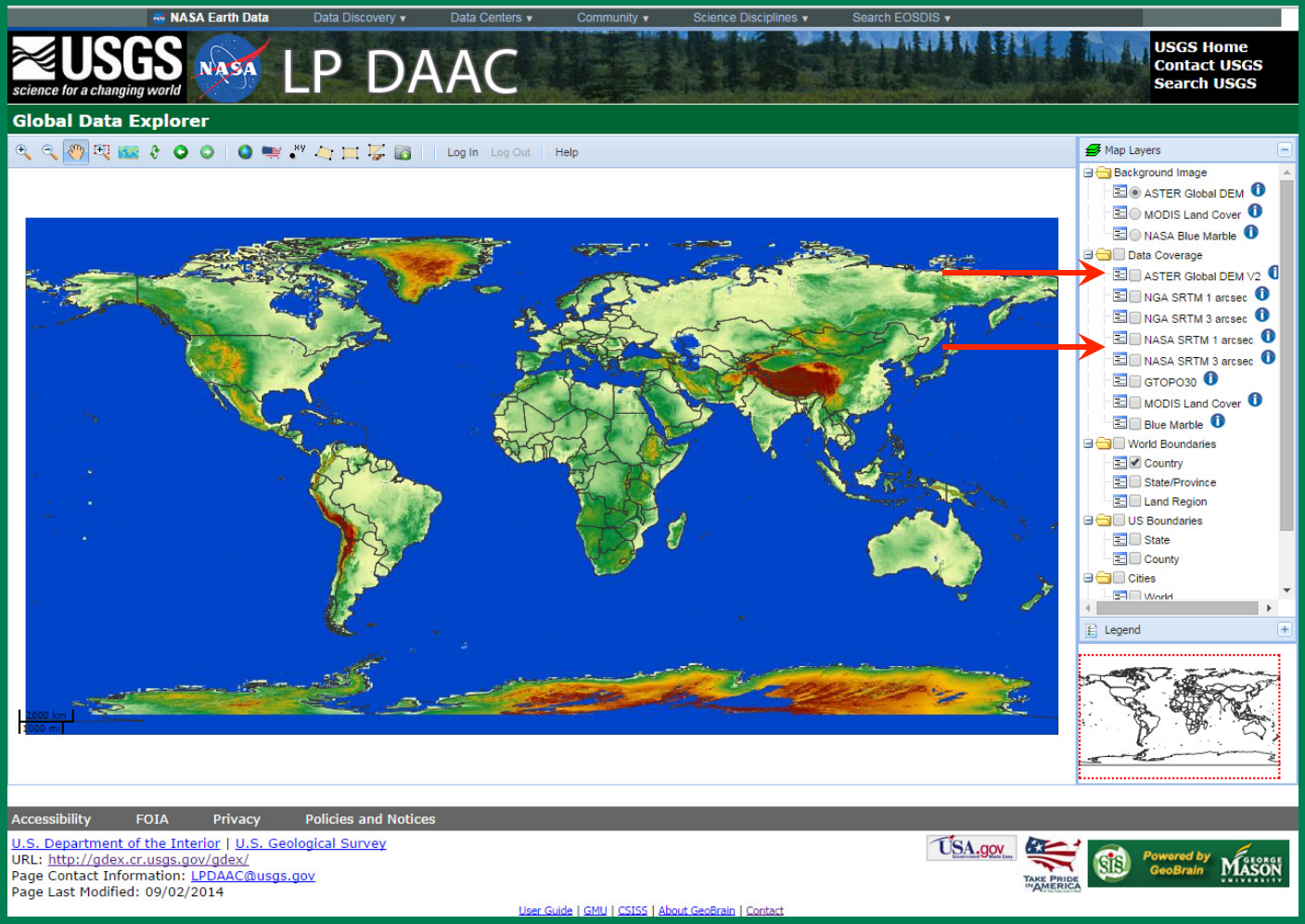
GDEx



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GDEx Features and Functions

- NASA ECHO/Reverb user account required to download data
- Product documentation and User Guide
- Square or polygonal area of interest
- Pre-defined areas of interest (state, county)
- Advanced, on-the-fly processing
  - Mosaic tiles into coverage clipped to AOI
  - Reformat to GeoTIFF, ArcASCII, or JPEG
  - UTM or LAT/LON projection
- Preview data before download

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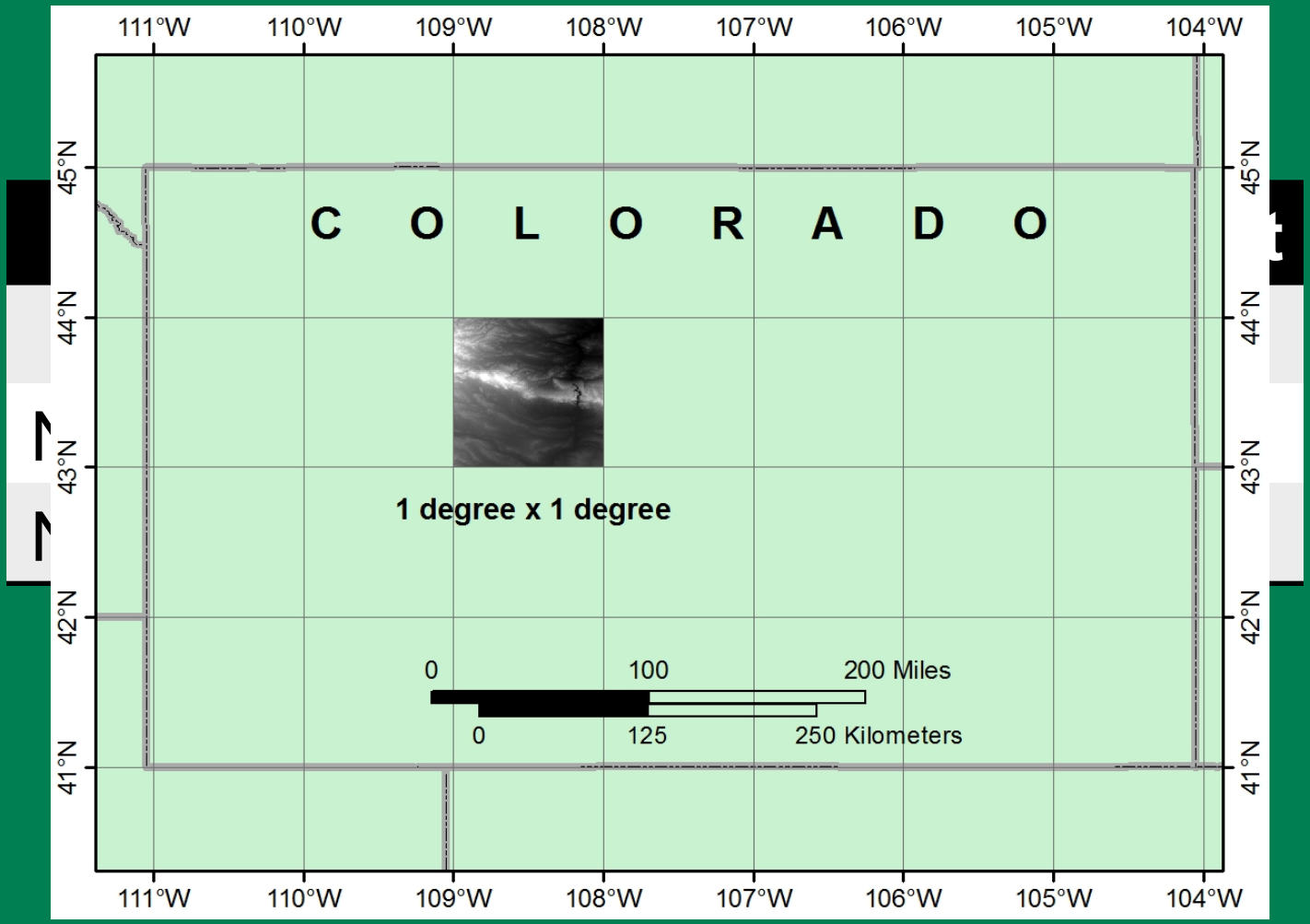
GDEx Tile Limits



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GDEx Demo

File Edit View History Bookmarks Tools Help

Global Data Explorer (Powe...

gdex.cr.usgs.gov/gdex/

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USGS science for a changing world

LP DAAC

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Global Data Explorer

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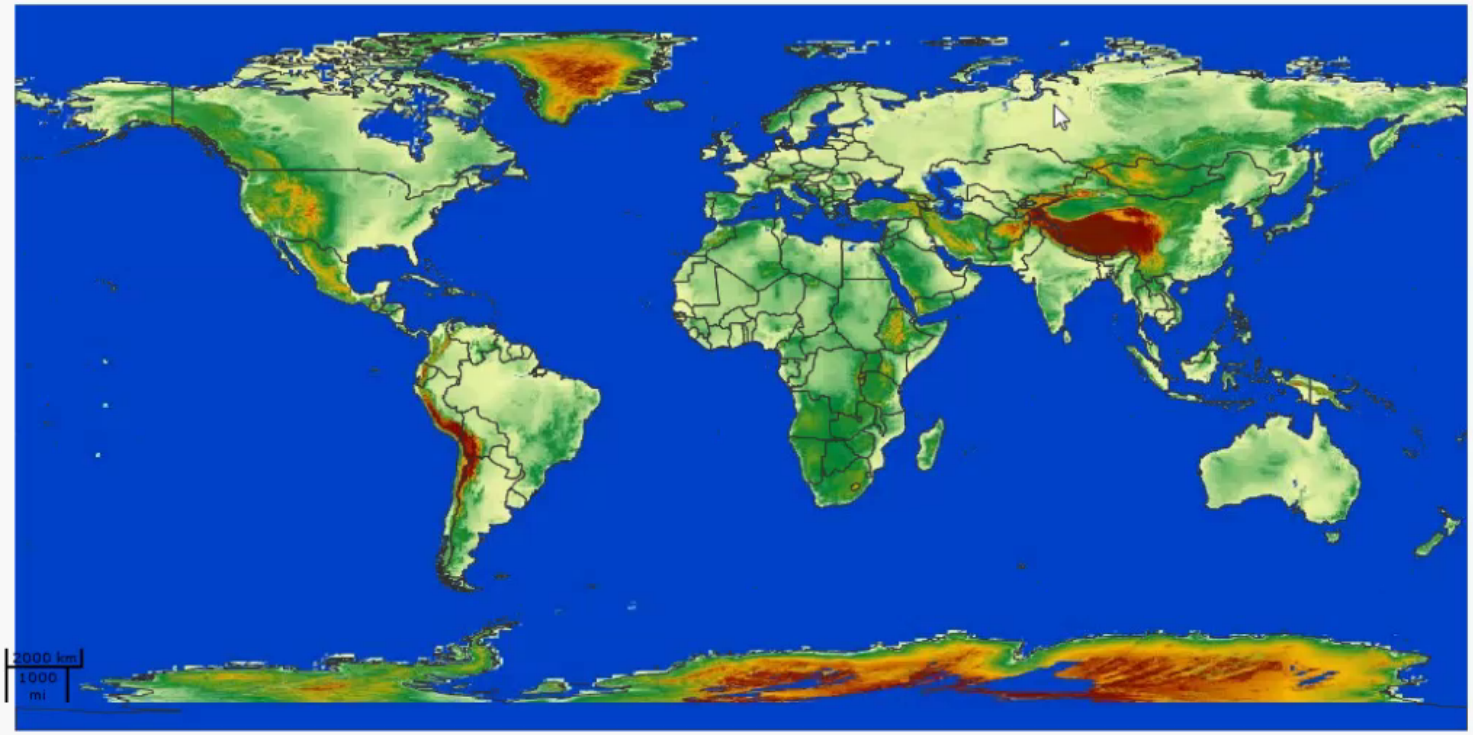

Map Layers

- Background Image
  - ASTER Global DEM
  - MODIS Land Cover
  - NASA Blue Marble
- Data Coverage
  - ASTER Global DEM V2
  - NGA SRTM 1 arcsec
  - NGA SRTM 3 arcsec
  - NASA SRTM 1 arcsec
  - NASA SRTM 3 arcsec
  - GTOPO30
  - MODIS Land Cover
  - Blue Marble
- World Boundaries
  - Country
  - State/Province
  - Land Region
- US Boundaries
  - State
  - County

Legend

Accessibility FOIA Privacy Policies and Notices

U.S. Department of the Interior | U.S. Geological Survey
URL: http://gdex.cr.usgs.gov/gdex/
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Questions

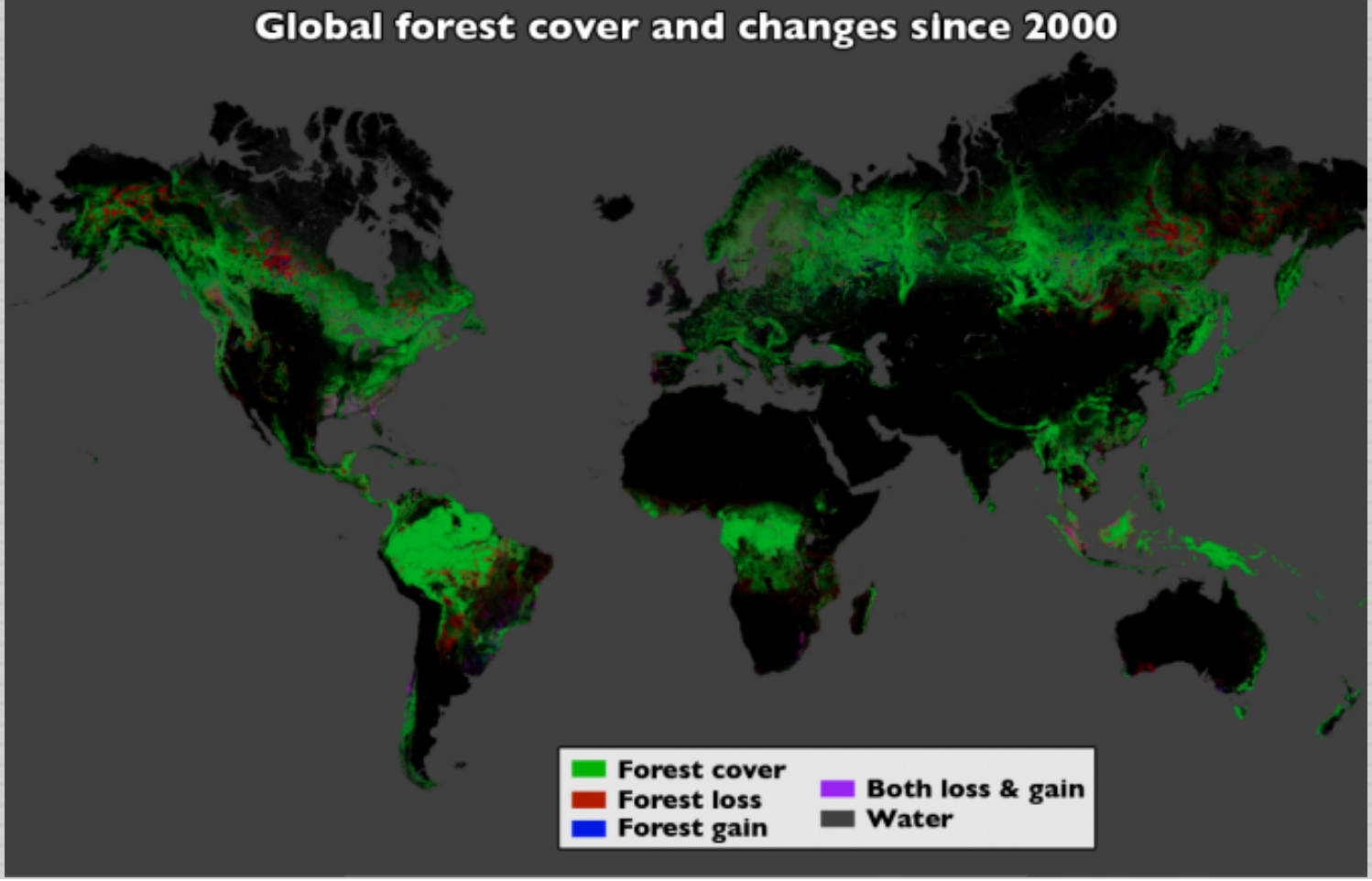
Coming up next week!

Change Detection using Landsat and MODIS

Landsat, Global forest cover and change since 2000.

(NASA Goddard, based on data from Hansen et al., 2013)

November 17, 2014



Thank You!!

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